

Comparison of Three Types of Low-calorie Diets on Blood Glucose and Lipid Control in Diabetic Patients

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ABSTRACT

BACKGROUND: Serum glucose levels can get close to a normal level by an appropriate diet. The present study aims to investigate the effect of low-calorie diets (1200, 1500, 1800 Kcal) on glucose and lipid levels, and HbA1C serum levels of newly diagnosed type II diabetic patients.

MATERIALS AND METHODS: This prospective cross-sectional study was conducted among 68 patients with type II diabetes mellitus, whose disease was recently diagnosed. The study criteria included fasting blood glucose higher than 126 mg/dL, HbA1c higher than 7% and BMI higher than 25. Fasting blood glucose levels, 2-hour post-prandial blood sugar and blood lipids were measured before and after intervention. Then, the patients were trained by an expert. After completing the questionnaires, the data were analyzed.

RESULTS: In this study, the mean fasting blood glucose level in patients who used 1200, 1500 and 1800 kcal diets decreased significantly after intervention ($p < 0.05$). In addition, fasting blood glucose levels and 2-hour post-prandial blood sugar decreased significantly using 1500 and 1800 kcal diets, while the 1200 kcal diet significantly reduced fasting blood glucose, triglyceride (TG), cholesterol (Chol), LDL, and hemoglobin A1C (HbA1c). There was a significant decrease in triglyceride based on the 1500 kcal diet in terms of gender.

CONCLUSION: Using low-calorie diets (1200, 1500 and 1800 kcal) in newly diagnosed diabetic patients can lead to blood sugar and lipid control in these patients, and among these diets, the use of a 1500 kcal diet can be more useful because of lower limitation and better tolerance and acceptance.

KEY WORDS: Low-calorie diet, newly diagnosed diabetes mellitus, blood glucose, serum lipid, HbA1C.

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INTRODUCTION

Diabetes is one of the most common diseases caused by metabolic disturbances, and according to some analysts, is the most common endocrine disorder. Today, diabetes is the fifth cause of mortality in western societies and is the fourth most common cause for referral to the physician¹. About 90% to 95% of diabetics suffer from type II diabetes^{2,3}. Blood glucose levels can be controlled by following a proper diet, exercising and using blood glucose-lowering medication. If the diet is properly regulated, you can provide the patient with the energy and nutrients needed. In the early stages, type II diabetes can be treated with weight loss and physical activity⁴. In overweight individuals, a mean 5-10 kg weight loss reduces hyperglycemia.

More than 4.5 million people suffer from diabetes in Iran, with a prevalence of 12% in the adult population, and it is appraised that by the year 2030, about 9 million Iranian people will have diabetes^{5,6}. Rapid

changes in lifestyle in different countries have contributed to an increase in the prevalence of obesity and other non-communicable diseases, including hypertension and lipid disorders, which appears to be a major contributor to the increase in the incidence of diabetes worldwide. Diet therapy is an important part of the treatment plan for patients with type II diabetes, which decreases the intake of sugar, saturated fats, cholesterol, and increases the intake of fruits and vegetables and dietary fiber, and improves serum lipid levels, regulates blood glucose, helps maintain or lose weight, and reduces complications of diabetes. In addition, gender, age, and race are important factors that determine the risk factors for type II diabetes⁷. Studies that have been conducted on lifestyle interventions in people with impaired glucose tolerance have shown that progress towards type II diabetes can be delayed or prevented⁸.

A diet containing 10-20% total calories from protein, 55-60% carbohydrates, and 25-30% fats, which is less

than 10% total calories of saturated fat, is an appropriate diet. The results of the studies indicate that eating four times within 10 hours during the day can improve the glucose status of the patients^{4,9}.

Reducing average daily calorie intake to 250-500 kcal and increase in physical activity is also helpful. Several studies have shown that proper education and nutrition have a significant effect on diabetes-related outcomes such as proteinuria, hemoglobin A1C (HbA1c) and weight¹⁰.

The study of Harati et al. showed that interventions in lifestyle modification caused more than 65% reduction in the incidence of diabetes¹¹.

Another study indicated that fasting blood glucose in patients using 1200 and 1500 kcal diets was significantly reduced after intervention, and in this case, the 1500 kcal diet was more significant¹². Therefore, this study aims to investigate the effect of low-calorie diet on controlling the blood glucose and lipids in patients whose diabetes has been diagnosed recently.

METHODOLOGY

A sample of 99 patients with newly diagnosed non-insulin-dependent type II diabetes, who were referred to diabetes clinic of Babol University of Medical Sciences during April 2013 to August 2014, was conducted in this prospective cross-sectional study. Sixty eight people were included in the study, while 31 people were excluded from the study because of non-compliance with the diet. First, the fasting blood glucose, 2-hour post-prandial blood sugar, lipids, and HbA1C levels of the subjects were recorded at the first referral, while measuring weight, height, body mass index (BMI), activity, waist circumference and hip circumference. Then, low-calorie diets (1200, 1500 and 1800 kcal) based on 55% carbohydrates, 20% protein and 25% fat were designed by a nutritionist and patients with BMI higher than 25 (overweight and obesity) were trained by an expert. After about 1.5 months, blood glucose, lipid and HbA1C levels were measured again and were compared with the initial levels. In this study, only patients whose type II diabetes was newly diagnosed and their blood glucose and hemoglobin A1C levels were respectively higher than 126 mg/dL and 7%, had overweight BMI, and grade 1 to 3 obesity were included. In addition, patients with cardiovascular disease, liver and kidney disease, or pregnant and lactating women with diabetes and patients under 20 years of age were excluded from the study. Experiments were carried out in the laboratory by one person while the subjects were fasted during morning. Cholesterol (Chol) was measured by enzymatic method (Boehringer

Mann-heim, Lewis, UK), triglyceride was measured by an enzymatic method kit (Pars Azmoon, Iran) and glucose was measured by enzymatic method using Man's kit. The protocol was approved by the Ethical Committee of Babol University of Medical Sciences. Informed consent was completed by cases participating in this study.

The data collection tool was a questionnaire containing demographic information and patient test results. Then, the data was coded & entered into the SPSS 16 and were analyzed by t-test, paired t-test and ANOVA.

RESULTS

This study was performed on 68 newly diagnosed type II diabetic patients. 22 subjects underwent 1200 kcal diet (32.3%), 24 subjects underwent 1500 kcal diet (35.2%) and 22 subjects underwent 1800 kcal diet (32.3%), and the results were as follows:

15 patients (22%) were male and 53 (77.9%) were female, 44 patients (67.7%) were housewives, 6 (8.8%) were self-employed and 11 (16.1%) were employees. 56 patients (82.3%) lived in city and 9 (13.3%) lived in the village. In terms of education, 12 patients (17.6%) were illiterate, 22 (32.3%) had primary school education, 6 (8.8%) had high school education, 17 (25%) had diploma and 6 (8.8%) had a degree higher than diploma (Table I). The BMI in 32 patients (47%) was close to overweight, 20 patients (29.4%) had grade 1 obesity, 12 (17.6%) had grade 2 obesity, and 4 (5.8%) had grade 3 obesity.

As shown in Table II, all three diets significantly reduced fasting blood glucose ($p < 0.05$). 1500 kcal diet resulted in a significant decrease in fasting blood sugar and 2-hour post-prandial blood sugar, while 1200 kcal diet reduced the fasting blood glucose levels, TG, Chol, LDL, and HbA1C significantly. There was also no significant difference between the mean differences, before and after intervention, in fasting blood glucose, 2-hour post-prandial blood sugar, TG, LDL, HDL and HbA1C between the three types of diet, and the difference between the three diets was only significant in terms of Chol reduction ($p < 0.05$). Mean and standard deviation of the differences, before and after intervention, in lipid and glucose parameters in the diets showed that there was a significant difference in triglyceride reduction based on gender using a 1500 kcal diet; it was significantly higher among women ($P = 0.02$).

Significant differences were observed in the reduction of TG based on gender in the 1500 kcal diet, which was significantly higher in women compared to men ($p < 0.05$).

TABLE I: FREQUENCY DISTRIBUTION OF QUANTITATIVE AND QUALITATIVE VARIABLES IN THE SUBJECTS ACCORDING TO THE TYPE OF DIET

Variable / diet (kcal)		1800	1500	1200
Gender	Man	04	01	10
	Woman	18	23	12
Occupation	Housewife	16	17	11
	Employee	01	04	06
	Self-Employed	01	01	04
Place of residence	City	21	17	18
	Village	00	05	04
Education	Illiterate	05	04	03
	Primary School	11	04	07
	High School	01	03	02
	Diploma	03	09	05
	Higher Than Diploma	01	02	03

DISCUSSION

A balanced diet is an important part of the treatment program for patients with type II diabetes. There is much scientific evidence that prove these recommendations are effective in the treatment and prevention of diabetes, which leads to a reduction in the number of visits to the doctor, the need for medication, the number of admissions and the prevention of complications. As observed in this study, all three diets significantly reduced fasting blood glucose. The 1500 kcal diet resulted in a significant decrease in fasting blood sugar and 2-hour post-prandial blood sugar and the 1200 kcal diet reduced the fasting blood glucose levels, TG, Chol, LDL, and HbA1C.

Some studies showed that 1200 and 1500 kcal diets caused a significant decrease in fasting blood glucose levels in patients, which was consistent with the results of the present study¹². However, regarding lipid indices, the present study only showed significant differences in cholesterol, which may be due to the use of medication in mentioned study. The study of Fritz et al., suggests that diet and walking can decrease blood glucose and HbA1c levels in diabetic

TABLE II: THE MEAN SUGAR AND LIPID PARAMETERS BEFORE AND AFTER THE DIET IN THE STUDY SUBJECTS

P-Value	Difference, before and after intervention Mean \pm SD	P-value	After intervention Mean \pm SD	Before intervention Mean \pm SD	Diet	Parameter
Fasting blood sugar (FBS)	1200	174.4 \pm 34.1	156.1 \pm 37.7	0.028	18.3 \pm 35.4	0.178
	1500	183.1 \pm 51.2	141.1 \pm 49.5	0.001	41.3 \pm 44.1	
	1800	182.7 \pm 64.3	142 \pm 47.8	0.002	40 \pm 55.4	
2-hour post-prandial blood sugar (2hpp)	1200	266.8 \pm 71.4	204.3 \pm 69.8	0.168	22.5 \pm 68.3	0.556
	1500	217.7 \pm 77.6	174 \pm 62.1	0.003	40.1 \pm 56	
	1800	231.4 \pm 84.8	211.4 \pm 86.6	0.252	20 \pm 73.8	
Triglycerides	1200	230.1 \pm 95.3	187.17 \pm 58.3	0.011	48.3 \pm 76.2	0.618
	1500	246.1 \pm 108.8	232 \pm 156.4	0.692	14 \pm 148.2	
	1800	242.6 \pm 172.4	226.6 \pm 229.1	0.592	16 \pm 134	
Cholesterol	1200	228.8 \pm 49.8	198 \pm 23.3	0.011	30 \pm 48	0.006
	1500	183.2 \pm 70.8	205.3 \pm 39.6	0.128	22 \pm 61.8	
	1800	189.1 \pm 59.8	199.9 \pm 48.7	0.286	30 \pm 68	
LDL	1200	125.6 \pm 50.3	121 \pm 40.2	0.025	4.5 \pm 37.9	0.400
	1500	16.6 \pm 27.1	105.9 \pm 22.8	0.072	10.7 \pm 18.7	
	1800	113.1 \pm 47.1	122 \pm 55.7	0.516	9.4 \pm 46.6	
HDL	1200	39.7 \pm 5.1	40.6 \pm 11	0.687	0.941 \pm 9.4	0.362
	1500	46.5 \pm 7.3	52.3 \pm 18.3	0.25	5.8 \pm 18.3	
	1800	44.92 \pm 21.1	41.75 \pm 10.4	0.594	3.1 \pm 19.9	
HbA1C	1200	9.4 \pm 2.35	8.2 \pm 1.8	0.001	1.2 \pm 9.6	0.124
	1500	6.6 \pm 1.2	6.3 \pm 1.2	0.435	0.312 \pm 1	
	1800	7.4 \pm 2.2	7.2 \pm 2	0.668	235 \pm 2	

patients¹³.

Keshavarz et al., regarding the effect of the number of meals in non-insulin-dependent diabetic patients, showed that using an 8-meal diet can reduce blood glucose and increase glucose tolerance in these patients¹⁴. Harati et al.'s study indicated that lifestyle modification caused more than 65% reduction in the incidence of diabetes¹¹. Asif also found that the best way to prevent complications of diabetes is to get the right diet along with exercise and medication⁴. Kam et al. concluded that daily food intake of diabetic patients does not have a satisfactory nutritional value due to inappropriate attitude and performance in these patients regarding dietary choices and regulation of diet¹⁵. Failure in the treatment of this disease is often due to a lack of a proper and balanced diet.

In the present study, low-calorie diets (1200, 1500 and 1800 kcal) were designed based on 55% carbohydrates, 20% protein and 25% fat. These diets are mainly different in terms of bread and cereal unit, meat unit and fat unit; in the 1800, 1500 and 1200 kcal diets, the units of bread and cereals were 10.5, 8 and 6 units, the units of meat and related products were 4.5, 5 and 2.5 units, and the units of fat were 5.5, 3 and 3 units, respectively. Although the difference between the unit of bread and cereal, meat and fat in the 1800 and 1500 kcal diets is not significant, this difference is significant in the case of 1,200 kcal diet. Based on the present study, the use of all three types of diet alone would lead to a reduction in blood glucose. However, the 1200 Kcal diet, which showed a more significant decrease, can alone be used. Although that there are many studies in the world about diets and diabetes, few studies have been conducted in this regard.

Moore H et al. also showed that low-calorie diets along with exercise can effectively reduce hemoglobin glycosylated in diabetic type II patients¹⁶. Boden G et al., in a study of low-carbohydrate diet in type II diabetic patients, found that low-carbohydrate diet in obese patients with diabetes mellitus could improve blood glucose and HbA1c status¹⁷. Van Gaal L et al. used a very low-calorie diet in diabetic patients and concluded that blood glucose reached normal levels after 9 months. Therefore, they suggested that diet and weight loss are to be considered before starting treatment in obese diabetic patients¹⁸.

The results of the studies on blood lipids showed that there was a significant difference between the mean values of blood cholesterol levels, before and after the intervention, but a 1200 kcal diet reduced the TG, HbA1C and LDL levels significantly.

Van Gaal L also succeeded in using a very low-calorie diet and discontinuing the medications of a patient with hyperlipidemia in a 9-month course to return the

patient's blood lipids to normal¹⁸. Franz et al. found that using the MNT (Medical Nutrition Therapy) method, they can control the weight and improve the blood glucose and lipids¹⁹. Evert AB et al. also found that the type of diet had a direct effect on serum lipids using energy and dietary constraints¹⁰. In this study, the use of low-calorie diets (1200, 1500, and 1800 kcal) significantly reduced the TG index based on gender, while in some studies, there was a significant difference in the use of low-calorie diets (1200 and 1500 and 1800 kcal) in controlling blood glucose and lipids based on gender.

Since the role of exercise, regular physical activity and a proper diet in controlling and preventing diabetes has been confirmed, appropriate education in diet, physical activity and lifestyle changes can delay or prevent type II diabetes.

CONCLUSION

Due to the prevalence of this disease in the community and patients' lack of knowledge about nutritional value and the adequacy of the consumed food, educating patients to raise awareness and improve performance in the form of comprehensive programs and nutrition education courses based on balanced diets can be a way to control, and treat better and prevent these patients from complications of diabetes.

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CONFLICT OF INTERESTS

None declared.

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